

**Improved Pen Mouse****ABSTRACT**

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A pointing device having an elongated body with a transparent end adapted for movement over a surface is disclosed. An illumination subsystem illuminates the surface in an area adjacent to the transparent end, and an imaging subsystem forms images of a portion of the surface in that area. The present invention also includes a reference mark system that  
10 defines a direction that is independent of rotations of the elongated body. A controller periodically compares two of the images to determine the distance and direction that the transparent end moved between the two images. The controller utilizes the direction defined in the reference mark system to reduce the computational workload. In one embodiment, the reference mark system includes a disk that is free to rotate about an axis through the disk and  
15 a sensor, and the position of a reference mark that is displaced from the axis is measured.